Attachment 1

Proposed Regulation Order
Verification Procedure for In-Use Strategies
to Control Emissions from Diesel Engines

§ 2700. Applicability.

These procedures apply to in-use strategies to control emissions of particulate matter (PM) and oxides of nitrogen (NOx) from diesel-fueled diesel engines. Strategies to be evaluated by these procedures include but are not limited to, diesel particulate filters, diesel oxidation catalysts, fuel additives, selective catalytic reduction systems, exhaust gas recirculation systems, and alternative diesel fuels.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2701. Definitions

(a) The definitions in Section 1900 (b), Chapter 1, Title 13 of the California Code of Regulations apply, with the following additions:

(1) "Alternative Diesel Fuel" means any fuel used in diesel engines that is not a reformulated diesel fuel as defined in section 2281 and 2282 of Title 13, of the California Code of Regulations, and does not require engine or fuel system modifications for proper operation. Examples include but are not limited to biodiesel fuels, Fischer Tropsch fuels, and emulsions of water in diesel fuel.
(2) "Average" means the arithmetic mean.
(3) "Backpressure Monitor" means a device that includes a sensor for measuring the engine backpressure upstream of a diesel emission control system and an indicator to notify the operator when the backpressure exceeds specified high and low backpressure limits, as defined by the engine manufacturer or the diesel emission control system applicant.
(4) "Baseline" means the test of a vehicle or engine without the diesel emission control strategy implemented.
(5) "Cold Start" means the start of an engine after it has been off for at least twelve hours and has cooled down to a temperature between 68 and 86 degrees F.
(6) "Diesel emission control strategy" or "Diesel emission control system" means any device, system, or strategy employed with an in-use diesel vehicle or piece of equipment that is intended to reduce emissions. Examples of diesel emission control strategies include, but are not limited to, particulate filters, diesel oxidation catalysts, selective catalytic reduction systems, fuel additives

in combination with particulate filters, alternative diesel fuels, and combinations of the above.

(7) **"**Diesel Engine" means an internal combustion engine with operating characteristics significantly similar to the theoretical diesel combustion cycle. The primary means of controlling power output in a diesel cycle engine is by limiting the amount of fuel that is injected into the combustion chambers of the engine. A diesel cycle engine may be petroleum-fueled (i.e., diesel-fueled) or alternate-fueled.

(8) "Durability" means a vehicle's or engine's ability to maintain a given emissions reduction or level and mechanical integrity over some period of time or distance defined by the Executive Officer. The minimum durability testing periods contained herein are not necessarily meant to be representative of the useful life of the diesel emission control strategy in actual service.

(9) "Emergency/Standby Engine" means an internal combustion engine used only as follows: (1) when normal power line or natural gas service fails; or (2) for the emergency pumping of water for either fire protection or flood relief. An emergency standby engine may not be operated to supplement a primary power source when the load capacity or rating of the primary power source has been either reached or exceeded.

(10) "Emission control group" means a set of diesel engines and applications defined by various engine and application parameters that are relevant to the performance of a particular diesel emission control strategy. The parameters depend on the nature of the diesel emission control strategy and may include, but are not limited to, engine emission certification levels, combustion cycle, displacement, aspiration, horsepower rating, duty cycle, exhaust temperature profile, and fuel composition. Verification of a diesel emission control strategy and the extension of existing verifications is done on an emission control group basis.

(11) "Executive Officer" means any officer or employee of the Air Resources Board so designated in writing by the Executive Officer or by the Executive Officer's designee.

(12) "Executive Order" means the document signed by the Executive Officer that specifies the verification level of a diesel emission control strategy and includes any enforceable conditions and requirements necessary to support the designated verification.

(13) "Fuel Additive" means any substance designed for addition to fuel or fuel systems that meet any of the following criteria: decreases emissions, improves fuel economy, increases performance of either the entire vehicle or component part, or achieves any combination there of; or aids other diesel emission control strategies in decreasing emissions, or improving fuel economy or increasing performance of either the entire vehicle or component part, or any combination thereof.

(14) "Fuel Borne Catalyst" means a fuel additive containing one or more fuel-soluble metals, that acts as a catalyst to lower the temperature at which regeneration occurs within a diesel particulate filter.

(15) "Hot Start" means the start of an engine within four hours after the engine is turned off.

(16) "Low Sulfur Diesel Fuel" means diesel fuel with a sulfur content less than 15 parts per million by weight (ppmw).

(17) "Portable Diesel-Fueled Diesel Engine" means a diesel-fueled diesel engine which is designed and capable of being carried or moved from one location to another and does not remain at a single location for more than 12 consecutive months. Engines used to propel mobile equipment or a motor vehicle of any kind are not portable engines. Examples of portable diesel-fueled engine applications include, but are not limited to cranes, pumps, welders, woodchippers, tactical support equipment (military), power generation sets, pile-driving hammers, service or work-over rigs, dredges or boats or barges, and compressors.

(18) "Regeneration" means the periodic or continuous combustion of collected particulate matter trapped in a particulate filter through an active or passive mechanism. Active regeneration requires a source of heat other than the exhaust itself to regenerate the particulate filter. Examples of active regeneration strategies include the use of fuel burners and electrical heaters. Passive regeneration does not require another source of heat for regeneration other than the exhaust stream itself. Examples of passive regeneration strategies include the use of fuel-borne catalysts and the catalyst-coated particulate filter.

(19) "Stationary Diesel-Fueled Diesel Engine" means either a diesel-fueled diesel engine that is used in a piece of equipment that is designed to remain in one location for the duration of its useful life, or a diesel-fueled diesel engine that is used in an equipment unit that can be moved from one location to another but remains in a single location for more than 12 consecutive months. Examples of stationary applications include, but are not limited, to electric power generator sets, grinders, rock crushers, sand screeners, cranes, cement blowers, compressors, and water pumps.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2702. Application Process

(a) Overview. Verification of a diesel emission control strategy for use with an emission control group requires that the applicant submit a proposed verification testing protocol, have said protocol approved by the Executive Officer, perform emission reduction testing (section 2703), durability testing (section 2704), a field demonstration (section 2705), and submit results along with comments and other information (sections 2706 and 2707) in an application to the Executive Officer, following the format shown in section 2702(d). If the Executive Officer verifies the diesel emission control strategy, it will issue an Executive Order to the applicant stating the verified emission reduction and

any conditions that must be met for the diesel emission control strategy to function properly. The applicant is also responsible for conducting in-use compliance testing (section 2709) after having sold a specified number of units. A diesel emission control strategy that involves two or more individual systems or components must be tested and evaluated as one system. Applicants seeking verification of an alternative diesel fuel must follow the procedure described in section 2710.

(b) Proposed Verification Testing Protocol. Before formally submitting an application for the initial verification of a diesel emission control strategy, the applicant must submit a proposed verification testing protocol for Executive Officer approval. The protocol must include the following:

(1) Identification of the contact persons, phone numbers, names and addresses of the responsible party which will be submitting an application.
(2) Description of the diesel emission control strategy's principles of operation and a schematic depicting operation.
(3) Preliminary parameters for defining emission control groups that are appropriate for the diesel emission control strategy. The Executive Officer will work with the applicant to determine appropriate emission control group parameters.
(4) The applicant's plan for meeting the requirements of sections 2703-2706. Existing test data may be submitted for the Executive Officer to determine if they partially satisfy these requirements. The protocol must focus on verification of the diesel emission control strategy for use with a single emission control group.

(c) Within 30 days of receipt of the proposed verification testing protocol, the Executive Officer shall determine whether the applicant has identified an appropriate testing protocol to support an application for verification and notify the applicant in writing that it may submit an application for verification. The Executive Officer shall specify any modifications to the verification testing protocol necessary to support verification of the diesel emission control strategy. The applicant and the Executive Officer may mutually agree to a longer time period for reaching a decision, and additional supporting documentation may be submitted by the applicant before a decision has been reached. Upon receiving approval of the testing protocol from the Executive Officer, the applicant may submit a formal application for verification. All application, correspondences, and reports must be submitted to: Air Resources Board, Chief, Heavy-Duty Diesel In-Use Strategies Branch, 9528 Telstar Avenue, El Monte, CA 91731.

(d) Application format. The applicant must follow the following format in the application for verification of a diesel emission control strategy:

1. Introduction

1.1 Applicant, manufacturer, and product identification
1.2 Type of verification being sought
1.2.1 Description of emission control group selected
1.2.2 Emission reduction claim

1.3 Status of Vehicle Code 27156 exemption

2. Diesel Emission Control Strategy Information

2.1 General description of the diesel emission control strategy
- 2.1.1 Discussion of principles of operation and system design
- 2.1.2 Schematics depicting operation

2.2 Description of regeneration method (where applicable)
- 2.2.1 Operating condition requirements for regeneration (where applicable)
- 2.2.2 Thresholds and control logic to activate regeneration (where applicable)
- 2.2.3 Description of backpressure monitor including threshold and control logic (where applicable)

2.3 Favorable operating conditions

2.4 Unfavorable operating conditions and associated reduction in performance

2.5 Fuel requirements and misfueling considerations

2.6 Identification of failure modes and associated consequences

2.7 Discussion on all potential safety issues *(e.g., uncontrolled regeneration, lack of proper maintenance, extended periods of vehicle idling, etc.)*

2.8 Installation requirements

2.9 Maintenance requirements

3. Alternative Diesel Fuel Information (under development)

3.1 Physical properties

3.2 Emission control group compatibility considerations

4. Diesel Emission Control Strategy and Diesel Emission Control Strategy Group Compatibility

4.1 Compatibility with the engine
- 4.1.1 Dependence of calibration and other design features on engine characteristics
- 4.1.2 Effect on overall engine performance
- 4.1.3 Effect on engine backpressure
- 4.1.4 Additional load on the engine (where applicable)
- 4.1.5 Effect on fuel consumption
- 4.1.6 Engine oil consumption considerations

4.2 Compatibility with the application
- 4.2.1 Dependence of calibration and other design features on application characteristics
- 4.2.2 Presentation of typical exhaust temperature profiles, PM emission rates, and other relevant field-collected data for the intended application
- 4.2.3 Comparison of field-collected application data with operating conditions suitable for the diesel emission control strategy

5. Testing Information

5.1 Emission reduction testing
- 5.1.1 Test facility identification
- 5.1.2 Description of test vehicle and engine *(make, model year, engine family name, etc.)*
- 5.1.3 Test procedure description *(de-greening period, test cycle, etc.)*
- 5.1.4 Test results and comments

5.2 Durability testing
- 5.2.1 Test facility identification
- 5.2.2 Description of field application (where applicable)
- 5.2.3 Description of test vehicle and engine *(make, model year, engine family name, etc.)*
- 5.2.4 Test procedure description *(field or bench, test cycle, etc.)*
- 5.2.5 Test results and comments

5.3 Field demonstration (where applicable)
- 5.3.1 Field application identification
- 5.3.2 Description of test vehicle and engine *(make, model year, engine family name, etc.)*
- 5.3.3 Engine backpressure and exhaust temperature graphs with comments
- 5.3.4 Summary of evaluative comments from third-party *(e.g., driver or fleet operator)*

6. References

7. Appendices

A. Laboratory test report information *(for each test)*
- A.1 Raw test data
- A.2 Plots of engine backpressure and exhaust temperature
- A.3 Driver traces for chassis dynamometer tests
- A.4 Quality assurance and quality control information

B. Third-party letters describing performance

C. Diesel emission control system label

D. Owner's manual
- D.1 Installation procedure
- D.2 Maintenance requirements
- D.3 Backpressure monitor instructions (if applicable)
- D.4 Fuel requirements
- D.5 Fuel penalty
- D.6 Durability statement
- D.7 Warranty and liability policy
- D.8 Contact information for waste disposal
- D.9 Contact information for replacement components and maintenance supplies
- D.10 Safety considerations

E. Other supporting documentation

(e) Within 30 days of receipt of the application, the Executive Officer shall notify the applicant whether the application is complete.

(f) Within 90 days after an application has been deemed complete, the Executive Officer shall determine whether the diesel emission control strategy merits verification and shall classify it as shown in Table 1 below:

Table 1. Verification Classifications for Diesel Emission Control Strategies

Pollutant	Reduction	Classification
PM	< 25%	Not verified
	≥ 25% but < 50%	Level 1
	≥ 50% but < 85%	Level 2
	≥ 85%, or ≤ 0.01 g/bhp-hr	Level 3
NOx	< 15%	Not verified
	≥ 15%	Verified in 5% increments

The applicant and the Executive Officer may mutually agree to a longer time period for reaching a decision, and additional supporting documentation may be submitted by the applicant before a decision has been reached. The Executive Officer shall notify the applicant of the decision in writing and specify the verification level for the diesel emission control strategy and identify any terms and conditions that are necessary to support the verification.

(g) Extensions of an existing verification. If the applicant has already verified a diesel emission control strategy with one emission control group and wishes to extend the verification to include additional emission control groups, it may apply to do so using additional test data, engineering justification, and any other information deemed necessary by staff.

(h) Design modifications. If an applicant modifies the design of a diesel emission control strategy that has already been verified or is under consideration for verification by the Executive Officer, the applicant must notify the Executive Officer in writing within 30 days. The notification must include a detailed description of the design modification along with an explanation of how the modification will change the operation and performance of the diesel emission control strategy. If the previous design configuration of the diesel emission control strategy was already verified by the Executive Officer, the modified version must also be verified. To this end, the applicant may submit additional test data, engineering justification, and any other information deemed necessary by staff.

(i) Treatment of confidential information. Information submitted to the Executive Officer by an applicant may be claimed as confidential, and such information shall be handled in accordance with the procedures specified in Title 17, California Code of Regulations, Sections 9100-91022. The Executive Officer may consider such confidential information in reaching a decision on a verification application.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2703. Emission Testing Requirements.

(a) The applicant must test the diesel emission control strategy on an emission control group basis and identify the emission control group. The applicant must identify the test engine and vehicle, if applicable, by providing the EPA engine family name make, model, model year, and PM and NOx certification levels if applicable. The applicant must also describe the applications for which the diesel emission control strategy is intended by giving examples of in-use vehicles or equipment, characterizing typical duty cycles, indicating any fuel requirements, and/or providing other application-related information.

(b) Engine Pre-conditioning. The applicant may tune-up or rebuild the engine only prior to baseline testing. A test conducted subsequent to a tune-up or rebuild will be considered a baseline test.

(c) Diesel Emission Control System Pre-conditioning. The engine installed with a diesel emission control system must be operated for a break-in period of between 25 to 125 hours before the emission testing.

(d) Test Fuel.

(1) The test fuel must meet the specifications in the California Code of Regulations (Sections 2280 through 2283 of Title 13), with the exception of the sulfur content or other properties previously identified by the applicant and approved by the Executive Officer.
(2) The sulfur content of the test fuel must be no less than 66 percent of the stated maximum sulfur content for the diesel emission control strategy, unless the testing was performed with fuel containing less than 15 ppmw sulfur.
(3) Testing of transit buses must use low-sulfur diesel fuel.
(4) Baseline testing may be conducted with commercially available diesel fuel or low-sulfur diesel fuel.
(5) The test fuel (or batch of fuel purchased) must be analyzed using American Society for Testing and Materials (ASTM) test methods. At a minimum, sulfur content, aromatic content, polycyclic aromatic hydrocarbons, nitrogen content, and cetane number must be reported. The Executive Officer may ask for

additional properties to be reported if evidence suggests those properties may affect functioning of the diesel emission control strategy.

(e) Test Cycle. The diesel emission control strategy must be tested with an engine or vehicle on the test cycles indicated in Table 2 or with alternative cycle(s) approved by Executive Officer as per (f) below.

Table 2. Test Cycles for Emission Reduction Testing*

Test Type	On-Road	Off-Road (including portable engines)	Stationary
Engine	FTP Heavy-duty Transient Cycle (1 cold-start and 3 hot-starts)	Steady-state test cycle from ARB off-road regulations (3 hot-starts)	Steady-state test cycle from ARB off-road regulations (3 hot-starts)
Chassis	UDDS (1 cold-start and 3 hot-starts) and ARB approved test cycle per 2704 (f) (3 hot-starts).	Not Applicable	Not Applicable

* Additional hot-starts are required for NOx emission reduction between 15 to 25 percent (see section 2703 (h).
FTP = Federal Test Procedure
UDDS = Urban Dynamometer Driving Schedule

(1) On-road Engines and Vehicles. For on-road diesel-fueled vehicles, the applicant may choose between engine dynamometer testing and chassis dynamometer testing, subject to the following conditions. Engine testing may be used for verification of an absolute engine emissions level or a percent emission reduction. Chassis testing may be used only to verify a percent emission reduction. The applicant may use emission test data towards the durability test data requirement, but must follow the same testing option for the remaining durability tests (see Section 2704).
(A) Engine testing must consist of one cold-start and at least three hot-start tests using the Federal Test Procedure (FTP) Heavy-duty Transient Cycle for engines used in on-road applications, in accordance with the provisions in the Code of Federal Regulations, Title 40, Part 86, appendix I (f)(2).
(B) The applicant must conduct all chassis tests in accordance with the provisions of the Code of Federal Regulations, Title 40, Part 86, Subpart N. Chassis testing must include two separate test cycles as follows:
(i) One cold-start and at least three hot-start tests using the Urban Dynamometer Driving Schedule (UDDS) (see Code of Federal Regulations, Title 40, Part 86, appendix I (d)).

(ii) Three hot-start tests using a low-speed chassis test cycle representing urban stop-and-go traffic operation. The test cycle must include a repetitive series of idling periods immediately followed by moderately severe vehicle acceleration events. The applicant can propose, for Executive Officer approval, a low-speed cycle as applicable to the type of vehicle and vehicle operation for which the diesel emission control strategy is intended. The Executive Officer will provide examples (e.g., New York Bus Cycle) of appropriate test cycles upon request by the applicant during the verification process.

(C) For any diesel emission control strategy that reduces NOx during "off-cycle" operation, the applicant must propose an appropriate test cycle. The Executive Officer will evaluate the proposed test cycle based on the following criteria:

(i) Representativeness of real-life operation, and

(ii) Consistency with established procedures for determining off-cycle emissions.

(2) Off-road Engines and Equipment (including portable engines). For off-road diesel-fueled vehicles and equipment, the applicant must follow the steady-state test cycle outlined in the ARB off-road regulations (California Code of Regulations, Title 13, Section 2423 and the incorporated California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines, Part I-B). A minimum of three hot-start tests must be conducted for each appropriate test cycle.

(3) Stationary Engines. For stationary engines, the applicant must use the most appropriate off-road test cycle representing the operating conditions of the application, with approval from the Executive officer. A minimum of three hot-start tests must be conducted for each appropriate test cycle.

(f) Alternative Test Cycles and Methods. The applicant may request the Executive Officer to approve an alternative test cycle or method in place of a required test cycle or method. The Executive Officer will review the alternative using the following criteria: (1) similarity of average speed, percent of time at idle, average acceleration, and other characteristics to the specified test cycle or method, (2) body of existing test data generated using the alternative test cycle or method, (3) technological necessity, and (4) technical ability to conduct the required test.

(g) Test Run. Baseline tests (without the diesel emission control strategy implemented) must be repeated for each cycle at least as many times as the control tests (see Table 2). For each baseline and control test run, engine backpressure and exhaust temperature must be measured and recorded on a second-by-second basis.

(h) Verification of NOx Emission Reductions. The procedure for verifying NOx reductions depends on the magnitude and nature of the reductions as follows:

(1) For NOx reductions of 25 percent or greater relative to baseline NOx emissions, the testing protocol described in (e) may be used.
(2) For NOx reductions of 15-25 percent relative to baseline NOx emissions, additional hot-start test runs are required. Each set of three hot-starts in Table 2 must be augmented to five hot-starts for 20-25 percent NOx reductions, and to eight hot-starts for 15-20 percent NOx reductions. Therefore, to test an on-road NOx diesel emission control strategy (that reduces NOx between 15 to 20 percent) on a chassis dynamometer, one cold and eight hot-start UDDS and eight hot-start low-speed cycle tests are required. Similarly, durability testing requires one cold and eight hot-start tests.

(i) Emissions During Regeneration Events. For any diesel emission control strategy that has a distinct regeneration event, emissions that occur during the event must be measured and taken into account when determining the net emission reduction efficiency of the system. If a regeneration event will not occur during emission testing, applicants may pre-load the diesel emission control system with diesel PM to force such an event to occur during testing, subject to the approval of the Executive Officer. Applicants must provide data indicating when events occur on test cycles and in actual operation (e.g. backpressure data).

(j) Results. For all emission tests, including incomplete and aborted tests, the applicant must report emissions of total PM, non-methane hydrocarbons or total hydrocarbons (whichever is used for the relevant engine or vehicle certification), oxides of nitrogen, and carbon monoxide.
(1) For mobile sources, or for engines tested using an engine dynamometer, emissions must be reported in grams/mile (g/mile) or grams/brake horsepower-hour (g/bhp-hr).
(2) For stationary engines, gaseous and particulate matter emissions must be reported as required by the approved test methods.

(k) Additional Exhaust Analyses. The Executive Officer may require the applicant to perform additional exhaust analyses if there is reason to believe that the installation of a diesel emission control system may result in the increase of toxic air contaminants, other harmful compounds, or a change in the nature of the emitted PM.
(1) In its determination, the Executive Officer may consider the following criteria:
(A) The addition of any substance to the fuel, intake air, or exhaust stream
(B) Whether a catalytic reaction is known or reasonably suspected to increase toxic air contaminants or ozone precursors
(C) Results from scientific literature
(D) Field experience and
(E) Any additional data.
(2) These analyses include, but are not be limited to, measurement of the following:
(A) benzene
(B) 1,3-butadiene
(C) formaldehyde

(D) acetaldehyde
(E) polycyclic aromatic hydrocarbons (PAH)
(F) nitro-PAH
(G) ammonia
(H) nitrogen dioxide
(I) PM size/number distribution.

(l) Quality Control of Test Data. The applicant must provide information on the test facility, test procedure, and equipment used in the emission testing. For data gathered using on-road and off-road test cycles and methods, applicants must provide data establishing that the test equipment used meets specifications and calibrations given in the Code of Federal Regulations, Title 40, Part 85, subpart N.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2704. Durability Testing Requirements

(a) The applicant must demonstrate, to the satisfaction of the Executive Officer, the durability of the diesel emission control strategy's emission reductions through actual field or laboratory-based testing in the form of a chassis or engine dynamometer test. If the applicant chooses laboratory-based testing, an additional field demonstration test will be required to demonstrate in-field compatibility (as per Section 2705). If the applicant has demonstrated durability for the identical system in a prior verification or has demonstrated durability through field experience, the applicant may request the Executive Officer to accept the previous demonstration. In evaluating such a request, the Executive Officer will consider relevant information including, but not limited to, the similarity of baseline emissions and application duty cycles, the relationship between the emission control group used in previous testing and the current emission control group, the number of engines tested, evidence of successful operation and user acceptance, and published reports.

(b) Engine Selection. Subject to the approval of the Executive Officer, the applicant may choose the engine and application to be used in the durability demonstration. The engine and application must be representative of the emission control group for which verification is sought. The selected engine need not be the same as the engine used for emission reduction testing, but if the applicant does use the same engine, the emission reduction testing can also be used for the initial durability tests.

(c) Test Fuel.

(1)The test fuel must meet the specifications in the California Code of Regulations (Sections 2280 through 2283 of Title 13), with the exception of the sulfur content or other properties previously identified by the applicant and approved by the Executive Officer.

(1) The sulfur content of the test fuel must be no less than 66 percent of the stated maximum sulfur content for the diesel emission control strategy, unless the testing was performed with fuel containing less than 15 ppmw sulfur.

(2) Testing of transit buses must use low-sulfur diesel fuel.

(3) Baseline testing may be conducted using commercially available diesel fuel or low-sulfur diesel fuel.

(5) The test fuel (or batch of fuel purchased) must be analyzed using ASTM test methods (at a minimum, sulfur content, aromatic content, polycyclic aromatic hydrocarbons, nitrogen content, and cetane number should be measured).

(d) Service Accumulation. The durability demonstration consists of extended periods of time in which the diesel emission control strategy is implemented in the field or in a laboratory, with periodic emission reduction testing. The minimum durability demonstration periods are shown in Table 3.

Table 3. Minimum Durability Demonstration Periods

Engine Type	Minimum Durability Demonstration Period
On-Road	50,000 miles or 1000 hours
Off-Road (including portable engines) and Stationary	1000 hours
Stationary emergency generator	500 hours

(e) Test Cycle. Only one test cycle is required, and the same cycle must be used throughout the entire durability demonstration.

(1) On-Road Applications. The applicant must perform either chassis or engine dynamometer-based testing at the three intervals specified in Table 4. If a field durability demonstration is selected, the applicant must perform chassis dynamometer testing, or request the Executive Officer to consider engine dynamometer testing. The Executive Officer will review the request using the following criteria: (1) similarity of the field vehicle's engine to the laboratory engine, and (2) similarity of the diesel emission control system's calibration and set-up when installed on the field vehicle to that when installed on the

laboratory engine. A minimum of one cold-start and three hot-start tests are required.

(2) Off-road and Stationary Applications. The applicant must use the same cycle for the emission reduction testing as defined in Section 2703. A minimum of three hot-start tests are required.

(f) Test Run. The required emission reduction testing is shown in Table 4. The diesel emission control strategy must undergo three sets of emission tests over the course of the durability demonstration period: one at the beginning, one between 33 to 67 percent of the durability period, and one at the end of the durability demonstration period. Baseline testing (without the diesel emission control strategy implemented) is required only at the first and last test. If there are substantial test data from previous field studies or field demonstrations, applicants may request the Executive Officer to waive the initial emission tests. Engine backpressure and exhaust temperature upstream of the diesel emission control system must be measured and recorded over the entire durability test. The measurements must be recorded at time intervals between one and five seconds over the entire durability demonstration period.

Table 4. Emission Tests Required for Durability Demonstrations

Application	Test Type	Test 1 (0% of durability period)	Test 2 (33 to 67% of durability period)	Test 3 (100% of durability period)
On-Road	Engine	FTP Heavy-duty Transient Cycle (1 cold and 3 hot-starts)		
	Chassis	UDDS or ARB-approved low-speed test cycle (1 cold and 3 hot-starts)		
Off-Road and portable engines	Engine	Steady-state test cycle from ARB off-road regulations or an alternative cycle (3 hot-starts)		
Stationary	Engine	Steady-state test cycle from ARB off-road regulations or an alternative cycle (3 hot-starts)		

Note that baseline testing (without the diesel emission control strategy implemented) is required only in Tests 1 and 3.

(g) Maintenance During Durability Demonstration. Except for emergency engine repair, only scheduled maintenance on the engine and diesel emission control system and re-fill of additives (if any) may be performed during the durability demonstration. If normal maintenance includes replacement of any component of the diesel emission control system, the time (miles, years, or hours) between component change or refill must be included with the results of the demonstration.

(h) Performance Requirements. Throughout the durability demonstration period, the diesel emission control strategy must meet the following requirements:

(1) If the applicant claims a percent emission reduction, the percent emission reduction must not be less than the initial verified percent emission reduction level.
(2) If the applicant claims to achieve 0.01 g/bhp-hr, the emission level must not exceed the 0.01 g/bhp-hr emission level.
(3) The diesel emission control system must maintain its physical integrity. That is, its physical structure and all components not specified for regular replacement must remain intact and fully functional.
(4) The diesel emission control strategy must not cause any damage to the engine.
(5) The diesel emission control strategy must not impose a higher backpressure to the engine than the allowable maximum specified for this engine and application.
(6) Maintenance of the diesel emission control system beyond that specified in its owner's manual will only be allowed with prior Executive Officer approval.

(i) Conditional Verification for Off-road and Stationary Applications. If the Executive Officer is convinced that the diesel emission control strategy is technologically sound and appropriate for the intended application, a conditional verification may be granted upon completion of 33 percent of the minimum durability period. Criteria considered by the Executive Officer include, but are not limited to, the design of the diesel emission control system, filter and catalyst substrates used, similarity to already verified systems, the intended application of the diesel emission control system, other relevant testing data, and field experience. Full verification is contingent on completion of the durability testing and submission of test results. These results must be submitted within a year after receiving conditional verification if laboratory testing is chosen and within three years if field testing is chosen.

(j) Failure During the Durability Demonstration Period. If, for any reason other than engine failure, the diesel emission control strategy does not maintain its initial verified percent emission reduction or emission level, the Executive Officer will downgrade the system to the verification level corresponding to the degraded performance, depending on the percent reduction from emission test results. If the diesel emission control strategy fails to maintain at least a 25 percent PM reduction or 15 percent NOx reduction during the durability period, the diesel emission control strategy will not be verified. If the diesel emission control strategy fails in the course of the durability demonstration period, the applicant must submit a report explaining the circumstances of the failure within 90 days of the failure. The Executive Officer will then determine if the applicant should continue the durability demonstration after fixing the failed diesel emission control system or begin a new durability demonstration.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2705. Field Demonstration Requirements.

(a) The applicant must demonstrate successful operation and compatibility of its diesel emission control strategy in the field with at least one vehicle or engine belonging to each emission control group it chooses for verification. The Executive Officer will consider existing field experience and engineering justification to determine whether additional emission control groups require separate field demonstrations. If the durability test selected is a field test, it may be used to satisfy the field demonstration requirement for that emission control group.

(b) Test Period. A vehicle or piece of equipment must be operated with the diesel emission control strategy installed for a minimum period of 200 hours or 10,000 miles, whichever occurs first. For stationary emergency generators, the test period is 100 hours.

(c) Reporting Requirements. A written statement from an Executive Officer approved third party, such as the owner or operator of the vehicle or equipment used in the field demonstration, must be provided at the end of the test period describing overall performance, maintenance required, problems encountered, and any other relevant comments. The results of a visual inspection must also be described.

(d) Failure During Field Demonstration. If the diesel emission control strategy fails in the course of the field demonstration, the applicant must submit a report explaining the circumstances of the failure within 90 days of the failure. The Executive Officer will then determine if the applicant should continue the field demonstration after fixing the failed diesel emission control system or begin a new field demonstration.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2706. Other Requirements.

(a) Limit on Nitrogen Dioxide (NO_2). To be determined.

(b) Fuel Additives. Additional requirements apply to diesel emission control strategies that use fuel additives. Fuel additives must be used in combination with a diesel particulate filter unless they can be proven to be safe for use alone. In addition,

(1) The applicant must submit the exact chemical formulation of the fuel additives.

(2) All diesel emission control strategies that use additives stored in a separate tank on the vehicle or equipment must have a fill level monitor to notify the operator when refill is necessary.
(3) The applicant must submit to the Executive Officer all environmental, toxicological, epidemiology, and other health-related data pertaining to the fuel additive every two years. The Executive Officer will review the data, including any new information, every two years and may revoke the verification if the data indicate that the fuel additives cause, or are linked, to negative environmental, or health problems.
(4) The applicant must conduct additional emission tests of fuel additives that contain heavy metals. The additional emission tests must follow the same test procedures, test cycles, and number of test runs as indicated in section 2703, except at a higher concentration of the metal constituent. The metal in these test solutions must be identical to that in the fuel additive submitted for verification, but at a concentration that is at least 50 ppm or an order of magnitude greater.

(c) Engine Backpressure and Monitoring. During the emission and durability testing, the applicant must demonstrate that the backpressure caused by its diesel emission control system is within the engine manufacturer's specified limits, or will not result in any damage to the engine. Furthermore,
(1) If operation of the engine with the diesel emission control system installed will result in a gradual build-up of backpressure exceeding the engine's specified limits over time (such as due to the accumulation of ash), information describing how the backpressure will be reduced must be included.
(2) All filter-based diesel emission control systems must be installed with a backpressure monitor to notify the operator when the backpressure limits, as specified by the engine manufacturers, are approached. The applicant must identify the low and high backpressure limits.

(d) Fuel and Oil Requirements. The applicant must specify the fuel and lubricating oil requirements for proper functioning of the diesel emission control system. The applicant must also identify any consequences due to non-compliance with these requirements, as well as methods for reversing any negative side-effects.

(e) Maintenance Requirements. The applicant must identify all normal maintenance requirements for the diesel emission control system. The applicant must specify the recommended intervals for cleaning and/or replacing components. Any components to be replaced within the defects warranty period must be included with the original diesel emission control system package or provided free of charge to the customer at the appropriate maintenance intervals. In addition, the applicant must specify procedures for proper handling and disposal of spent components and/or materials cleaned from the diesel emission control system. For filter-based diesel emission control strategies, the applicant must include procedures for resetting any backpressure monitors after maintenance procedures are completed.

(f) System Labeling. The applicant must affix a label on each diesel emission control system that identifies the applicant, model, and the month and year of manufacture. A scale drawing of a sample label must be submitted with the verification application.

(i) Additional Information. The Executive Officer may require the applicant to provide additional information about the diesel emission control strategy or its implementation when such information is needed to assess environmental impacts associated with its use.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2707. Defects Warranty.

(a) Defects Warranty. The applicant must provide a defects warranty for parts and emission control performance with a minimum coverage as shown in Table 5. For each engine type and size, the defects warranty period is that which occurs first. During the defects warranty period, the applicant will be liable for any defects in the diesel emission control system, backpressure monitor (if applicable), and all hoses or connectors to the diesel emission control system, that present themselves in the course of normal operation. A defect may be structural, mechanical, or chemical in nature. In addition, a diesel emission control system will be considered defective if during the warranty period, emission control performance falls below the verified level.

Table 5. Minimum Defects Warranty Periods

Engine Type	Engine Size	Minimum Warranty Period
On-Road	Light heavy-duty, generally 70 to 170 hp, GVWR normally less than 19,500 lbs.	5 years or 60,000 miles
	Medium heavy-duty, generally 170 to 250 hp, GVWR normally from 19,500 lbs. to 33,000 lbs.	5 years or 100,000 miles
	Heavy heavy-duty, generally exceeds 250 hp, GVWR normally exceeds 33,000 lbs.	5 years or 150,000 miles
Off-Road (includes portable engines) and Stationary	Under 25 hp, and for constant speed engines rated under 50 hp with rated speeds greater than or equal to 3,000 rpm	3 years or 1,600 hours
	At or above 25 hp and under 50 hp	4 years or 2,600 hours
	At or above 50 hp	5 years or 4,200 hours

(b) Diesel Emission Control Strategy Warranty Statement. The applicant must furnish a copy of the following statement in the owner's manual.

YOUR WARRANTY RIGHTS AND OBLIGATIONS

(Applicant's name) must warrant the diesel emission control system in the application for which it is sold for the periods of time listed below, provided there has been no abuse, neglect, or improper maintenance of your vehicle or equipment. Your diesel emission control system may include a core part (e.g., particulate filter, diesel oxidation catalyst, selective catalytic reduction converter) as well as hoses, connectors, a back pressure monitor (if applicable), and other emission-related assemblies. Where a warrantable condition exists, (applicant's name) will repair or replace your diesel emission control system at no cost to you including diagnosis, parts, and labor.

APPLICANT'S WARRANTY COVERAGE:

For a (engine size) engine used in a(n) (type of application) application, the warranty period will be (time or mileage) whichever occurs first.

(1) If your (vehicle, engine, equipment) fails the in-use compliance test within the warranty period, all necessary repairs or part replacements will be made by (applicant's name) to ensure your diesel emission control system PERFORMANCE WARRANTY.
(2) If any emission-related part of your diesel emission control system is defective in any way, the part will be repaired or replaced by (applicant's name) to ensure your diesel emission control system DEFECT WARRANTY.

OWNER'S WARRANTY RESPONSIBILITY

As the (vehicle, engine, equipment) owner, you are responsible for performing the required maintenance described in your owner's manual. (Applicant's name) recommends that you retain all receipts for diesel emission control system maintenance expenses, but (applicant's name) cannot deny warranty solely because you do not keep your receipts or fail to perform all scheduled maintenance. You are responsible for presenting your diesel emission control system to a (applicant's name) dealer as soon as a problem is detected. The warranty repair or replacement should be completed in a reasonable amount of time, not to exceed 30 days.

If you have questions regarding your warranty rights and responsibilities, you should contact (Insert chosen applicant's contact) at 1-800-xxx-xxxx or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731, or (800) 363-7664, or electronic mail: helpline@arb.ca.gov.

(k) Owner's Manual. The applicant must provide a copy of the diesel emission control system owner's manual, which must clearly specify at least the following information:

(1) Warranty statement including the warranty period over which the applicant is liable for any defects.
(2) Installation and maintenance requirements for the diesel emission control system.

(3) Possible backpressure range imposed on the engine.
(4) Fuel consumption penalty, if any.
(5) Fuel sulfur limit, if any.
(6) Handling and supply of additives, if any.
(7) Instructions for reading and resetting the backpressure monitor.
(8) Requirements for lubrication oil quality and maximum lubrication oil consumption rate.
(9) The applicant's contact information for replacement components and cleaning agents.
(10) Contact information to assist an end-user to determine proper ways to dispose of waste generated by the diesel emission control strategy (e.g., ash accumulated in filter-based systems). At a minimum, the owner's manual should indicate that disposal must be in accordance with all applicable Federal, State and local laws governing waste disposal.

(l) Noise Level Control. Any diesel emission control system that replaces a muffler must continue to provide at a minimum the same level of exhaust noise attenuation as the muffler with which the vehicle was originally equipped by the applicant. Diesel emission control strategies must be certified by their applicants to comply with all applicable noise limits contained in Part 205, Title 40, Code of Federal Regulations and California Vehicle Code Sections 27150, 27151 and 27200 through 27207, for the gross vehicle weight rating and year of manufacture of the vehicle for which the diesel emission control strategy is intended. Diesel emission control strategy applicants must maintain a list of vehicles (make, model, engine, gross vehicle weight rating, and year of manufacture) for which the diesel emission control strategy is thus certified. Diesel emission control systems may not be installed on vehicles not on that list.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2708. Determination of Emission Reduction.

(a) Calculation of Emission Reduction. The ARB's verification of a diesel emission control strategy's emission reduction will be based on the average of all valid test results before and after the installation of the diesel emission control system from emission and durability tests. The percentage reduction is the difference between the average emissions with (control) and without (or baseline emissions) the diesel emission control system divided by the average emissions without the diesel emission control system, multiplied by 100 percent as defined in the following equation:

$$\text{Percentage Reduction} = 100\% \times \frac{\Sigma\,(\text{baseline} - \text{control})/\text{baseline}}{\text{Number of baseline/control test pairs}}$$

The absolute emission level is the average emission level with the diesel emission control system, as defined in the following equation:

$$\text{Absolute Emission Level} = \frac{\Sigma\,(\text{control})}{\text{Number of tests}}$$

(b) Categorization of the Diesel Emission Control Strategy. ARB categorizes diesel emission control strategies to reduce PM and NOx emissions based on their verified emission reductions. Diesel emission control strategies for NOx control will be assigned their verified emission reduction in five percent increment. Diesel emission control strategies for PM control are categorized as follows:

(1) Level one: the system has been demonstrated under these procedures to reduce PM emissions by at least 25 percent but less than 50 percent from the baseline emission level.
(2) Level two: the system has been demonstrated under these procedures to reduce PM emissions by at least 50 percent but less than 85 percent from the baseline emission level.
(3) Level three: the system has been demonstrated under these procedures to reduce PM emissions by at least 85 percent from the baseline emission level, or to achieve PM levels of 0.01 grams per brake-horsepower-hour (g/bhp-hr) or less.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2709. In-Use Compliance Requirements

(a) Applicability. The in-use compliance requirements apply to diesel emission control strategies for on-road, off-road, and stationary applications. In-use testing is not required until at least 50 units of a specific model of a verified diesel emission control system have been sold in the California market. Applicants must submit an in-use compliance testing proposal for approval by the Executive Officer prior to the in-use compliance testing.

(b) Test Phases. The in-use compliance tests must be conducted at two different phases.

(1) Phase 1. Applicants must procure and test diesel emission control systems which have been operated for at least one year or within three months of its first maintenance, whichever comes first.
(2) Phase 2. Applicants must procure and test diesel emission control systems which have been operated between 60 and 80 percent of their minimum warranty period.

(c) Selection of Diesel Emission Control Systems for Testing. For each model of the diesel emission control system, the Executive Officer will identify a representative sample of diesel emission control systems for the in-use compliance testing. In addition, the engines or vehicles associated with the selected diesel emission control systems must have good maintenance records and may receive a tune-up or proper maintenance prior to testing. The applicant must obtain information from the end users regarding the accumulated mileage or hours of usage, maintenance records, operating conditions and a description of any unscheduled maintenance that may affect the emission results.

(d) Number of Diesel Emission Control Systems to be Tested. The number of diesel emission control systems to be tested by a applicant will be determined by the following method:

(1) A minimum of four diesel emission control systems must be tested. For each system tested that performs lower than 90 percent of its claimed verification level, two more diesel emission control systems must be procured and tested. This process is to continue as necessary, with the constraint that the total number of systems tested shall not exceed ten.

(2) At the discretion of the Executive Officer, applicants may test more than the minimum of four diesel emission control systems or may concede failure before testing a total of ten diesel emission control systems.

(e) In-use Emission Testing. Applicants must follow the testing procedure used for emission reduction verification as described in Section 2703. In addition, applicants must select the same test cycle(s) that they used to verify the diesel emission control strategy originally. If a diesel emission control system fails catastrophically during the in-use compliance testing, the applicant must provide an investigative report detailing the causes of the failure to the Executive Officer within 90 days of the failure.

(f) The Executive Officer may approve an alternative to the in-use testing thus far described if such testing is overly burdensome to either the applicant or the end-users because of the structure or uniqueness of the industry the diesel emission control systems are used in. The proposed alternative must be designed to determine whether the diesel emission control strategy is in compliance using a scientifically-sound methodology.

(g) In-Use Compliance Report. The applicant must submit an in-use compliance report to the Executive Officer within three months of completion of the in-use testing program. The following information must be reported for each diesel emission control system tested:

(1) Parties involved in conducting the in-use compliance tests.
(2) Quality control and quality assurance information for the test equipment.
(3) Model and manufacture date of the diesel emission control system.
(4) Engine or equipment the diesel emission control system was installed on.
(5) Estimated mileage or hours the diesel emission control system was in use.
(6) Results of all emission testing.

(7) Summary of all maintenance, adjustments, modifications, and repairs performed.

(h) Diesel Emission Control Strategy Warranty Report. The applicant must submit a warranty report to the Executive Officer by February 1 of each calendar year which includes the following information:

(1) Annual and cumulative sales of diesel emission control systems.

(2) Annual and cumulative production of diesel emission control systems.

(3) Annual summary of warranty claims. The summary must include:

(A) A description of the nature of the claims and of the warranty replacements or repairs. The applicant must categorize warranty claims for each diesel emission control system model by the component(s) replaced or repaired.

(B) The number and percentage of diesel emission control systems of each model for which a warranty replacement or repair was identified.

(C) A short description of the diesel emission control system component that was replaced or repaired under warranty and the most likely reason for its failure.

(4) Date the warranty claims were filed and the engine family and application the diesel emission control systems were used with.

(5) Delineate the reason(s) for any instances in which warranty service is not provided to end-users that file warranty claims.

(6) The Executive Officer reserves the right to request the manufacturer to perform additional in-use compliance testing if the warranty claims exceed two percent of the number of diesel engines using the diesel emission control strategy.

(i) Conditions for Passing the In-Use Compliance Program. For a diesel emission control strategy to pass compliance testing, emission test results must indicate emission reductions that are at least 90 percent of the initially verified emission reduction level. All four diesel emission control systems must pass the emission testing for full compliance. If there are failures and more units are tested, at least 70 percent of all units tested must pass. For each failed test, for which the cause of failure can be attributed to the product and not to maintenance or other engine-related problems, two or more additional units must be tested, up to a total of ten units.

(j) Failure of in-use compliance testing. The applicant must submit a remedial report within 90 days after the in-use compliance report is submitted. The remedial report must include:

(1) Summary of the in-use compliance report.

(2) Detailed analysis of the failed diesel emission control systems and possible reasons for failure.

(3) Remedial measures to correct or replace failed diesel emission control systems as well as the rest of the in-use diesel emission control systems.

(k) The Executive Officer must evaluate the remedial report, annual warranty report, and all other relevant information to determine if the applicant has addressed all

issues pertaining to the non-compliance of the diesel emission control strategy. Based on all relevant information, the Executive Officer may revoke the verification status.

NOTE: Authority cited: Sections 39600, 39601, 39650-39675, 43011, 43013, 43018 and 43105, Health and Safety Code. Reference: Sections 39650-39675, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, 43204-43205.5, 94105, and 94114 Health and Safety Code.

§ 2710. Verification of Alternative Diesel Fuels

To be determined.